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A VOCABULARY PROGRAM USING "LANGUAGE REDUNDANCY."

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THE THESIS OF THIS REPORT IS THAT REDUNDANT PARTS OF A SENTENCE MAY EITHER BE OMITTED OR REPLACED BY NONSENSE WORDS WITHOUT LOSS OF COMPREHENSION. AND IF THE NONSENSE WORDS ARE IN A LANGUAGE FOREIGN TO THE READER, THEIR CONSISTENT USE SHOULD EVENTUALLY EQUATE THEM TO EQUIVALENTS IN THE READER'S LANGUAGE. GRAMMATICAL STRUCTURE WILL ALSO BE ACQUIRED IN THIS WAY. THE READING MATTER SHOULD ASSURE CONTINUED INTEREST. THESE HYPOTHESES WERE TESTED BY WRITING A PROGRAM WHICH USED 350 GERMAN WORDS IN PLACE OF REDUNDANT ENGLISH WORDS IN 3 SHORT STORIES. AFTER 3 NON GERMAN-SPEAKING COLLEGE STUDENTS READ THE PROGRAM, THEY COULD TRANSLATE 60 PERCENT OF THE GERMAN WORDS WHEN THE WORDS WERE PRESENTED OUT OF CONTEXT. THE STUDENTS WERE ABLE TO MAKE STATEMENTS ABOUT GERMAN GRAMMAR, AND AGREED THAT THE EXPERIENCE WAS A PLEASANT ONE. THIS REPORT IS ONE OF A SERIES ON THE INVESTIGATION OF VARIATIONS IN THE PROPERTIES OF SELF-TUTORING LEARNING SEQUENCES. (LH)

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Articles published to date or in press in this series are:

1. J. Evans, R. Glaser, L. E. Homme
   The Ruleg System of Programming
2. R. Glaser
   Principles and Problems of Programming
3. J. Evans, R. Glaser, L. E. Homme
   An Investigation of "Teaching Machine" Variables Using Learning Programs in Symbolic Logic
4. J. Evans
   A Symbolic Logic Program for Use in Laboratory Experimentation
5. H. H. Schaefer
   A Vocabulary Program Using "Language Redundancy"
6. J. Taber, H. H. Schaefer, R. Glaser
   Symbols for Use in the Editing of Programmed Learning Sequences
7. J. Taber, R. Glaser
   A Discriminative Transfer Learning Program Using Literal Prompts

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SUMMARY

Breaking a large response repertoire such as the speaking of a foreign language into its minutest parts in respect to pronunciation, vocabulary, and grammar is the first step in analyzing the procedures for teaching this response repertoire. Making a person respond with these minute parts of a response repertoire in a controlled sequence constitutes good teaching and has recently quite aptly been called "programmed instruction". An essential feature of programmed instruction is immediate feedback to the student on the basis of which he can compare the correctness of his response and thus avail himself as much as possible to the reinforcing feeling of having been "right". This has led to teaching programs consisting of "frames" to which the student may make highly predictable (and thus correct) responses. But creating "frames" which elicit responses is by no means the only method of proceeding.

Redundant parts of a sentence may either be omitted or replaced by nonsense words without loss in the reader's understanding of the contents. If the "nonsense" words are words of a language presently unknown to the reader, their consistent use should equate them sooner or later to their equivalents in the reader's language. Similarly the grammatical structure of a new language may be acquired to some degree by phrasing the words of the known language according to the grammatical rules of the new language. To assure continued reading, the reading matter ought to be fascinating and appealing much in the sense that a mystery or detective story usually assures continued interest.

To test these hypotheses a program was written which used 350 German words in place of redundant words in E. A. Poe's stories "The Tell-Tale Heart", "The Black Cat", and "The Maelstrom". Three college students with no previous background in German speaking, hearing, or reading were asked to read the stories. They took from four to six hours to read the material. A subsequent test showed that they could translate simple sentences consisting of the German words they had learned by reading the stories in the context of which those words had appeared. They could correctly translate 60% of these German words when they were presented out of the story context. They were also able to make statements about German grammar, but were not systematically tested in this area. They all agreed that the experience had been pleasurable and satisfying.

Examples of this form of programming are given in this report and the rationale of the procedure is explained in detail.

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1. Introductory Remarks:

Learning a new language involves the learning of a variety of new skills which can be clearly distinguished: pronunciation, grammar, vocabulary, elegance of use, to name but a few.

Recent attempts have been made to teach the pronunciation of a foreign language without any regard to grammar or meaning of the new sounds that are being uttered. These attempts have been so incredibly successful that even native speakers would listen to sounds uttered by the foreign language learner and find it difficult to believe that the student is not himself a native speaker. No one has ever undertaken to teach the vocabulary of a language without regard to pronunciation. The technique presented here lends itself to teach a vocabulary and also a knowledge of the grammar of a foreign language. It is probably possible to teach vocabulary without any recourse to the new grammar. However, there is no doubt that to teach vocabulary without some recourse to the new grammar is probably more difficult.

This technique does not replace conventional language learning. Programs prepared according to this technique probably will serve excellently to enrich existing language courses in the sense that they allow the student to use a great variety of words from the very beginning in a meaningful way. The terminal behavior which can be achieved by this method is the understanding of sentences in the new language in a written form. A simple newspaper story, for example, can be read by a student who has gone through a program prepared in accordance with the technique to be presented here.

2. Basic Concepts Underlying this Form of Programming:

It is very rare in the every day situation that a controlled stimulus is not composed of many elements. Even so simple a stimulus as the green light which controls the human walking behavior at an intersection is inter-connected with so many other properties of the environment that the seasoned pedestrian usually attends to the accompanying stimuli more than he does to the green light as such: he will begin to walk, for example, when the amber appears on the other direction. He "knows" one might say, that green is due to appear now at any moment. In terms of information

theory notions there is enough redundancy in the traffic light situation to communicate even in the presence of considerable noise.

Language is another instance where redundancy is used to permit communication or control over behavior in the presence of noise and in more ways than one. Many less sounds than are conventionally used in grammatically and phonetically correct speech are necessary to communicate. For example, the sentence A line may be either curvilinear or straight, does not really need the word or for anything but a filler. The word or gives no additional information. It could be (and in certain codes it is) simply omitted.

In behavioral terms the words either....or constitute a control stimulus which need not be presented completely to be effective. A response to the sentence A line may be either curvilinear ____ straight would be essentially the same as that to A line may be either curvilinear or straight. Rather than omit the word or in the above sentence we replace it by the "nonsense" form which happens to be the equivalent word in a foreign language we wish to teach. We say, for example: A line may be curvilinear oder straight. Oder can have but one meaning in this context. Since it is understood that the subject is learning a new language, a justified conclusion would be that oder is another word that means or.

Often the situation is not so simple. It may be difficult to find a sentence where but one interpretation of a new "nonsense" stimulus is possible. In these instances we shall have to rely on subsequent recurrence of that stimulus in other connections which will not allow the wrong translation or substitution to survive. This is the process of stimulus discrimination and we know from laboratory work that it is an effective method of learning. Take for example: "A Kind follows the normal process of growth." It is possible here to learn that Kind means plant, tree, child, bacteria, city, or any other number of things. There is no telling which of these alternatives would be learned initially. The probability that the wrong one be learned is rather great. Subsequently, however, a sentence may occur that reads: "A Kind whose mother and father were dead.. ....." Already that would have excluded some of the meanings possible in the previous sentence such as plant, city, tree, etc. It is evident now how we limit the control function of the stimulus and the effect that it

has over the speaker. But it is still possible to substitute cat, dog, boy, girl, etc. Other sentences, however, will occur containing the word Kind which gradually will extinguish all but the correct response child to this stimulus. The last responses to disappear in this case very likely are the responses boy or girl to the stimulus Kind.

It might be argued that this is a very tedious and time consuming way to learn a simple word. It must be remembered, however, that words rarely are simple. The word in the above example is of neuter gender. It is a literal translation of the English child, however it is used in the German language in certain situations where the word child is not necessarily used. The opposite is true also. All of these things about the new word would have to be communicated in some other fashion if the student were to "learn" how to use the new word. To obtain this kind of knowledge, much of it quite unformulated, the method of "letting the student find out for himself" seems much more appropriate than to describe in lengthy instructions--if such could be given--the usage of the new word.

As behavioral analysts we must ask what the reinforcement is that makes learning under these conditions possible. The most obvious reinforcer in this situation might well be the contents of the reading matter which captures the reader to such a degree that he is willing to make the slight effort of tying the new word in with the known sentence contents. Another reinforcer, sometimes important sometimes of no effect, is the hope to be able to read another language. The beginning of a program based on the redundancy method is almost 100 percent in the native language; but the end of such a program is 100 percent in the foreign language. This quality of the program is pointed out to the student in some introductory statement. Lastly, there is a reinforcement of the general tact[1] of "getting something for nothing," or "getting by with something." This last kind of reinforcement probably works because learning a new language is traditionally beset with aversive stimuli of many kinds. It is very time consuming and the student is rather punished for being wrong than reinforced for being right. Any adult embarking upon the task of learning

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[1] The theoretical basis on which this programming technique was developed is B. F. Skinner's book, Verbal Behavior. A tact can be defined as a verbal operant in which the response of a given form is evoked (or at least strengthened) by a particular object or event or property of an object or event.

a new language knows this. With the present technique of programming, however, it is evident that the terminal behavior (reading in a foreign language) can be achieved in a very short time--measured in hours rather than in weeks, months, or years--and there is never any punishment for being wrong. To human beings, exposed daily throughout their lives to aversive control, this seems like nothing short of magic or a subtle form of cheating. They may express fears that"this can't work," but upon seeing that they have nothing to lose are willing to possibly, "waste" a few hours. They feel, in other words that if, contrary to their better knowledge this method proves to be successful with them, they have, indeed, gotten "something for nothing," an event which is to most of us highly reinforcing.

3. The Techniques of Introducing the New Words of a Language:

We may distinguish between three different kinds of words with which we are dealing in any language: (A) Skeleton words (a, the, and, but, or, in, out, have, take, make, etc.), (B) Common words (table, chair, floor, boy, girl, etc.), and (C) Rare words (extrapolate, manger, joist, mandipular, etc.). There is no general rule that can be given as to which words of these groups should be introduced first. Generally speaking, however, it is not unwise to begin with the skeleton words. These occur so often that the programmer hardly has to worry about the context in which he introduces them. Any lack of discrimination that may exist early due to poor programming is certain to disappear as the text progresses.

The most difficult words for the programmer are not the rare words, as one might suppose. These words usually occur in a context which makes it very easy to rely on the control exerted by the context of the sentence in which they are likely to occur. This is called a thematic prompt in programming. The word manger, rare as it is, can easily be identified in our culture in a sentence such as "Christ was born by a virgin in a stable and placed into a Krippe;" in fact it is easy to see how one might do even better than that relying on popular poetry on the topic. Idioms in the known language will serve excellently to introduce rare words because they form part of the existing response repertoire. The idioms of the new language, of course, have little or none of this control. Often they sound farfetched. The English, for example, has to put the cart before the horse. The English idiom in this case lends itself during any stage in the programming to get at such words as horse, before, and cart.

This leaves the common word group, and it is evident that greatest care and ingenuity on the part of the programmer are called for to find several stimulus situations for each of these words in which but one interpretation is possible. In fact, in introducing the common words it is most evident that this form of programming requires both linguistic knowledge and versatility in behavioral analysis. There are more ways than one in which the correct word can be "guessed" in a sentence. In introducing common words the programmer must rely more than in any other case on the process of gradual stimulus discrimination. He is free, for example, to introduce additional sentences in a text which repeat what has been already communicated in a slightly altered form which tends to extinguish wrong interpretations of a newly introduced word. He must also use his judgment to decide how important it is at this particular point in the program that the subject know the word absolutely correct. Sometimes this is not crucial. There are situations where it makes little difference in the understanding of a story whether a particular word is read as <u>child</u>, <u>boy</u>, or <u>girl</u>. There are, however, other situations where it is definitely important that a word be understood in its correct meaning since the rest of the story does not make sense any other way or would be distorted if the wrong meaning were used.

The program itself can be seen to fall into three distinct phases. In the <u>first phase</u> the programmer will introduce many of the skeleton words. In doing this he can do no more than plug them in at the appropriate places. The most efficient way of proceeding at this stage of programming is to cross out all those words in the English translation of the text--or the English original that is being used--that he wishes to replace. The typist then types from the printed page leaving underlined blanks at all those places where a word has been crossed out. As the programmer receives the typescript he fills in the blanks and enters all the words (in the new language) in a ledger with dividers from A to Z. Every time he inserts a word he notes in the ledger how often the word has occurred. Proceeding in this manner guarantees that the sentence is strong enough to make the meaning of a particular word that is to be inserted clear. This is often not obvious on first analysis, i.e., when the programmer crosses out words in the original text. If, as he receives the

typescript with the blanks, he finds that he has no difficulty in substituting the correct words, his original analysis has been satisfactory and there should be no difficulty on the part of the student in "guessing" the correct word. The typescript with filled in blanks is then handed back to the typist who prepares the final typing of the program with the blanks filled in with words of the new language. An example of the first phase is:

> True! - nervous, very, very dreadfully nervous, ich, had been, and am; but why will you say that ich am mad? The disease had sharpened meine senses - not destroyed, not dulled them. Above all was der sense of hearing acute. Ich heard all the things in dem heaven and der earth. I heard many things in hell. How, then, am ich mad? Hearken! Und observe how healthily--how calmly ich can tell die whole story.

The second phase of the program is that in which many of the skeleton words are assumed to be known by the reader already. Several common words have been introduced also. It is in this stage that the programmer begins to couch sentences in the grammatical form of the new language. Very few new words are introduced in this phase. Instead the subject learns to understand sentences when they appear in a grammatical order with which he is not familiar. There will, of course, be occasions in the writing of this second phase to introduce new words. As they occur they should be made use of.

It is not possible to give a hard and fast rule as to when the second phase begins, nor to say how long this phase should last. Naturally, it depends on the skill of the programmer on the one hand to cleverly shape single sentences using the existing response repertoire established up to this point; and, of course, also upon the special features of the language to be used. An example of the second phase is:

> Der second und third day went by und yet showed himself mein tormentor nicht. Again could ich as free man breathe. Das monster was apparently in great terror run away! Never again would ich es see! Meine happiness was complete! Die guilt der black deed disturbed mich but little. Some questions were asked und readily answered. Eine search was even undertaken, but, of course, could nichts be found. Ich looked einer safe future toward.

While sentences which violate all feelings of harmony and propriety which most lovers of language have will thus be frequent in the second phase, the programmer, nevertheless, must make use of grammatical habits of the subject for the sake of reinforcing the reader whenever he introduces the words. It is well for the programmer to remember that in using either the words of the new language in an awkward position or in placing the words of a known language in an impossible form, that it is the feelings of the accomplished speaker, not those of the learner which he offends. He should remember that the program is not written to please the programmer himself or the expert critic. It is written solely to teach the student a new response repertoire. This new response repertoire consists of being able to read and understand the new language. To obtain this behavior it is necessary to go through stages which will definitely be "wrong" both from the point of view of the speaker of the known language as from that of the native speaker of the new language. But the programmer knows full well that he must gradually shape the new behavior that he wishes to establish. Unlike Athena who sprang full-grown from the head of Zeus, the product emerging from a program goes through stages of making. These stages of making are quite visible in a program (they are not so visible in a conventional language teaching) and they look ugly. Conventional language teaching strives to have the student use the new language in a perfect form from the very beginning. This results in the introduction of childishly simple sentences of the type, "La plume de ma tante est sur le bureau du mon oncle; la papier de mon oncle est sur le bureau de ma tante." It is of interest to observe, however, that while we call such sentences childish they are hardly the kind of sentences that a child would utter. On the other hand, the kinds of sentences that the student will form in the present technique of programming do, especially at the early stage, sound very much like the babblings of a child. And it is not unlike a child learns to speak that the student is introduced to the new language. To say it in a general form: it is the terminal behavior that the programmer must have in mind; how he achieves it is of no concern; if he has to teach--temporarily--"wrong" habits in order to get there, he is perfectly willing to do so since he knows that no harm is done. He most certainly will not offend or hurt the student learner. He will, quite likely, offend his own sense of

aesthetics and that of the accomplished speaker of either the existing or the new language. This, however, does not concern him.

In writing for the second phase of the program it is most convenient for the programmer to utilize a dictating machine. He may either use the words of the new language as he dictates, or he may simply dictate "blanks" if his typist is not fluent in the new language. There is the possibility of spelling the new words of a foreign language so that even an unskilled typist could perform; however, it has been found that the burden placed upon the programmer by requiring this additional work is disturbing to the point that dictation becomes very cumbersome and confusing. It is probably better to dictate with "blanks" and then edit the typescript by inserting the proper words.

For the third phase the programmer has now available a small repertoire of words in the new language which he must use skillfully to form sentences in the proper grammatical order of the new language. This is at once the most rewarding and also the most difficult stage. Sentences have to be rewritten and simplified for the sake of the existing response repertoire which is contained in the words appearing in the ledger. The ledger must be consulted continuously. New words are introduced, as in phase 2, if the contents of the sentence makes this feasable. But the third phase will contain also many sentences in the proper grammatical order of the native language for the sake of introducing new common words. Gradually, as vocabulary increases, the text will be more and more in the new language. At some time during the third phase and perhaps during the second phase, the programmer does well to use an existing translation of the literature that he utilizes for his program. An example of the third phase is:

> Die slope seiner Wände wurde von Moment zu Moment smaller, und der bottom der Vortex seemed sich gradually zu lift. Der sky war klar, die Winde hatten sich died, und der moon went brightly im Westen down, als ich mich auf dem surface des Ozeans facing die coast von Lofoden found, exactly über der place, wo der Trichter des Moskoe- [illegible] gewesen war.

There are general considerations which are almost obvious: the programmer should keep track of the number of times that he uses the word of the new language in his program only up to a certain point. Empericially it has been found that if he notes that a word has been used 10 times it

is not necessary to indicate any further times that the word is used since, with considerable assurance, it can be assumed that the word is known after it has been used in context for 10 times. Since it may be of some interest to know approximately during which part of the program a particular word was used and since the program typically consists of a series of short stories, it is wise to indicate in the ledger at what section of the program what particular words have been introduced and practiced. The following is an example of a ledger:

WORD	STORY 1	STORY 2	STORY 3
Katze	1,2,3,4,5,6		
Kater	1,2,3,4		
klar	0	1,2,3,4	5
Kreatur	1,2		
Keller	1,2,3,4,5,6,7		
kein	1,2,3,4	5,6,7,8,9,10	
konnte	1,2,3,4	5,6,7,8,9,10	
kommen	0	1,2	3,4,5
kam	0	1,2	3
gekommen	0	0	0
kann	0	1,2,3,4,5,6,7,8,9,10	
klein	1,2	3,4	
können	1,2,3,4,5,6,7,8,9,10		
Konstellation	1		
Knie	0	1	
Kopf	1,2		

The programmer can either use colored pencils or straight lines with headings to indicate the story in which a word was used.

4. Modes of Presentation

The program appears in book form in either one of the following ways:

Mode (A) No overt response required. Here the reader is simply presented with a text which gradually shifts into the new language. The general idea is that the dictionary provided with the text (a dictionary which is no more than a reprint of the words collected in the ledger) may be used by the student as he is reading. The hypothesis underlying this form of presentation is that the use of the dictionary may be considered a highly aversive behavior which ought to extinguish as other behaviors becomes available which are less aversive and can be used to achieve the same result. In other words, if the student is

confronted with the new word whose meaning he does not know he is either free to consult the dictionary to find the correct meaning of that word and proceed to read a sentence or he can try to "guess" the meaning of the word from the context of the sentence and then proceed to read. Often the student may skip over words that he does not know and still understand roughly the meaning of the sentence. But as he continues to proceed in this way, he will soon find that he has to make use of a dictionary because the words over which he skipped are now assumed to be known. He now realizes that it is wise to not simply skip words that he doesn't understand but to spend the small effort of guessing their meaning. In other words it is assumed that in this mode of presentation the student begins the program and, typically, will skip words that he does not understand. Soon he will find out that having done this skipping will necessitate his using the dictionary in order to proceed to read. He will now find that the dictionary is a rather aversive method of aiding understanding and reading, and he will then realize that he may avoid the effort required to use a dictionary by making sure that he understands the word that is presented in the text by spending a little time in guessing what the word may be.

There are no instructions needed to bring this behavior about. Programming in this way is a straight application of behavioral engineering with the usual predictable results. The risk in this kind of programming is primarily that the alternate response to dictionary using is not reinforced early enough to persist and to replace the undesirable response. There are as yet no empirical data to substantiate the effectiveness of this mode of presentation. It is, however, probably a good method for students who have learned other languages and who have come to appreciate methods of learning new words which do not involve the dictionary. An example of this mode of presentation is:

> "Angel Holiday was <u>die</u> kind of woman who abhored no means to achieve an end. Following her philosophy she had achieved <u>die</u> following ends: a penthouse on <u>der</u> seaside, two outrageously expensive mink stoles, ...

Mode (B) Write in the first 10 times a word occurs. This mode of presentation provides a space at the margin of the text where the student is required to write in the word which is now on the corresponding line. The known language term should never be given. An example of this mode of presentation is:

"Angel Holiday was the kind of woman who abhored no means to achieve an end. Following her philosophy she achieved die following ends: a penthouse on der seaside, two outrageously expensive mink stoles, ...

_____ = _____
_____ = _____
_____ = _____

Shortcomings of this method are that the student may make up his own diction of the words which may be at odds with the proper pronunciation. Whether this is commonly true or not is not known at the present time.

Mode (C) Write in the first 10 times with pronunciation the first time. This means that the foreign word must be given once more at the margin. An example of this mode is:

"Angel Holiday was die kind of woman who abhored no means to achieve an end. Following her philosophy she had achieved die following ends: a penthouse on der seaside, two outrageously expensive mink stoles, ...

die(DEE)= _____
_____ = _____
dér(DARE)= _____

There are theoretical objections to this method of proceeding which need not be considered here.[1] Again it must be remembered that the terminal behavior dictates the methods that the programmer employs. In this case the terminal behavior consists of being able to read a newspaper in the new language. Theoretical consideration should never stand in the way of accomplishing this end. Since it is felt that a subject, in reading through the text, will make up his own way of pronouncing words as he reads them, it is not a bad idea to give him

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[1] Even the best phonetic system does not teach proper diction in a new language since the subject has not yet learned to discriminate the sounds of the new language. To the non-Latin speaker the "ah" sound that he makes as he pronounces the word father sounds like a perfectly acceptable Spanish "ah". This, however, is not true. There are at the moment programs available that teach proper diction of a new language entirely independent of understanding of words. It may be highly advantageous to use one of these methods in connection with the present programming technique.

hints as to what is an acceptable pronunciation. It is true that he does not learn to pronounce the words as a native speaker would, but is certainly true that he will reach a stage of approximation which, for the time being, may be regarded as satisfactory. At least, he certainly does not learn radically wrong pronunciation.

5. Experimental Tryout:

A program was prepared introducing 350 German words in the context of three stories by Edgar Allen Poe: "The Tell-tale Heart", "The Black Cat", and "The Maelstrom". Table I gives a list of the words.

Three subjects were given these stories to read. The mode of responding selected was that in which the first introduction of a word is accompanied with a bracketed phonetic writing at the margin. The subject is encouraged but not required to write in the words as they appear. All of the subjects, two female and one male, were undergraduate students. They had no previous knowledge of German and no member of their family speaks German.

6. Results:

The subjects' reading time for all of the stories was 6 hours, 5 hours, 4.5 hours respectively. No other material was used. After reading the material the subjects were given two tests. For Test 1, they were presented with a random sample of the introduced words out of context, and they were asked to give translations of these words. Table 2 summarizes the results of this test. In Table II also are given the number of times that the word occurred in the text. It should be noted that the words are counted only the first 10 times. If a word had occurred 10 times no further count of it was made.

The second test consisted of presenting the subjects with simple sentences (see Table III) all of which they translated without difficulty.

The success with which the subjects could pronounce the words varied greatly. It should be remembered that no formal programming was undertaken to teach pronunciation. The only reason for including the phonetic writing of words was the observation that subjects make up their own pronunciation as they go along and in view of anything better the approximation on the basis of English spelling were given. Table IV summarizes the preformance of the subjects on the word recognition test.

7. Discussion:

Table II shows that the number of times a word had been introduced into the text had no bearing on the surity with which it was learned by all the subjects. This is not especially surprising in view of the fact that many of the words bear a close resemblance to the English and that others have special qualities through existing verbal chains. It is apparent that a person who has training both as a linguist and as a behavioral scientist can most successfully program in this method.

It is certainly clear that it is not sheer frequency of repetition which teaches a particular word. Rather the properties which individual words have acquired in their functioning in the context of usage are the ones which assure learning.

It seems tempting to compare the success of the program with conventional learning within the scope of the 350 words used here. Such an attempt would, however, prove nothing at all. First of all, the subjects who took the program had at no time any feeling that any hardship was imposed upon them. Two of them had read the stories in question previously but they did not recall exactly what they were about. The other subject had not read the stories. This made not much difference upon the interest which the subject showed for the stories. Yet, at the end of a relatively short time they had a response repertoire which they previously had not had. In addition, however, they also knew quite a bit of grammar in the new language even though they could not formally state grammatical laws. One subject who had read passages of the text out loud had begun to pronounce in German, English letters such as a, if they occurred out of context. All of these things could, of course, be assessed and be compared with conventional learning but doing so would certainly not be one simple experiment. Any further investigation that is called for in this context--and it is much--should follow the pattern of analysis of verbal behavior suggested by B. F. Skinner in "Verbal Behavior" rather than that of comparison experiments.

There is no doubt that further stories in which additional words programmed in the same fashion will yield rather spectacular results, spectacular when used against the background of conventional language teaching. But it must not be forgotten that the present program was written by a person who is not a trained linguist, that the program as

it stands now has shortcomings due to the lack of knowledge in linguistics on the part of the programmer, that the science of verbal behavior itself is extremely young. If a program with all these handicaps can teach painlessly what is normally taught over a much longer period, we have proof, if proof were needed, that this method of programming certainly deserves further attention.

TABLE I

ALPHABETICAL LIST OF WORDS USED IN THE FIRST THREE STORIES

aber	but	dessen	whose (rel. Pron.)
Abhang	cliff, slope	dieser,-e,-es	this
absurd	absurd	der; die; das	the (nom.)
auf	upon, on	des; der; des	of the (gen.)
als	as, when, than	dem; der; dem	to the (dat.)
alt	old, of age	den; die; das	the (acc.)
alter,-e,-es	old	die; die; die	the (plur.)
an	on, to	der; der; der	the (gen. plur.)
anderer,-e,-es	other	den; den; den	the (dat. plur.)
anders	otherwise, different	die, die, die	the (acc. plur.)
		drei	three
Arm	arm		
Auge	eye	Ebbe	tide, low
aus	out, out of	Echo	echo
ausser	except, outside of	einer,-e,-es	a
		einige	some; several
alles	all	einziger,-e, -es	sole, solitary, single
absolut	absolute		
		Ende	end
beginnen, begann, begonnen	to begin	er	he
		erster,-e,-es	first
bei	at, by, which	erstens	primarily
Bein	leg	es	it
Bett	bed	etwa	approximately, about
Beste	best	Expedition	expedition
bin (sein)	am (to be)		
blind	blind	Faden	thread, fathom (ship)
Boot	boat	fallen; fiel, gefallen	to fall
Bord	bord (ship)		
Briese	breeze	Fass	barrel
Bruder	brother	Fenster	window
		Figur	figure
da	there	Finger	finger
dass	that (conj.)	Fisch	fish
Dämon	demon	fischen, fischte, gefischt	to fish
Deck	deck (ship)		

Flut	tide, high, flood
Form	form, mode, shape
Frau	woman, wife
Fundament	base, fundament
fünf	five
für	for
Furie	fury
Gedanken	thought
gewesen	been
gigantisch	gigantic
gleichen	to be like
Gott	god
Grad	degree
gross	large, big
haben, hatte, gehabt	to have
halb	half
Hand	hand
hängen, hängte, gehängt	to hang
Haus	house
heraus	out, out of
Herde	herd
Herren	men, gentlemen
hier	here
Horizont	horizon
Hurrikan	hurricane
ich	I
ihm	him
ihn	him, it
ihr	her, its, their, your
Ihr	their; your
ihrer,-e,-es	yours, theirs
im (=in dem)	in the
in	in, at, into
informiert	informed
innerer,-e,-es	inner
intelligent	intelligent
Insel	island
ist	is
Jahr	year
Kakophonie	cacophony
kann	(I) can
Kater	cat (male)
Katze	cat (female)
kein	no (=not any)
Keller	basement, cellar
klar	clear
klein	little
Knie	knee
kommen, kam, gekommen	to come
können, konnte, gekonnt	to can
Konstellation	constellation
Kopf	head
Kreatur	creature
lang	long
langer,-e,-es	long (adj.)
länger	longer
laut	loud
lauter	louder
Laterne	lantern
Licht	light
Mann	man
Männer	men
mehr	more
machen, machte, gemacht	to make
Meile	mile
Meter	meter
Minute	minute
mir	me
mit	with
Mitternacht	midnight
Moment	moment
Monster	monster
Muskel	muscle
mein, meine, mein	my (sing.nom.)
-es,-er,-es	(sing.gen.)
-em,-er,-em	(sing.dat.)
-en,meine,mein	(sing.acc.)
meine	my (plur.nom.all gen.)
meiner	(plur.gen.all gen.)
meinen	(plur.dat.all gen.)
meine	(plur.acc.all gen.)
nächst	next
Nacht	night
Nächte	nights
Name	name
Nerven	nerves
nicht	not

nie	never
noch	nor, still, yet, else
Norwegen	Norway
nun	now
nur	only
ob	if, whether
oder	or
offen	open
oft	often
Ohr	ear
Ozean	ocean
Papier	paper
Peripherie	periphery
Phenomen	phenomenon
Polizist	policeman
Polizisten	policemen
reflektiert	reflected
Rest	remnant, left-over
Riegel	bolt, latch
Ring	ring
sagen, sagte, gesagt	to say
Sand	sand
Scham	shame
scharf	sharp, keen
Schiff	ship
Schrei	scream; cry
Schreien	scream, cry
schreien schrie,geschr- ien	to scream, to cry
sechs	six
sehen, sah, gesehen	to see
seiner,-e,-es	his
sein	nis, its
selbst	itself,myself, etc.
selten	seldom
setzen, sass, gessessen	to sit
sieben	seven
sind	are
sie	it, she, they
Sie	you
sich	itself, myself, etc.
sinken, sank, gesunken	to sink
so	so, thus
sodass	consequently, so that
solid	solid
sondern	but, however
stark	strong
strom	stream
Strudel	whirlpool
Sturn	storm
Süd; Süden	South
Stöhnen	moan, groan
Tag	day
tausend	thousand
Teil	part
Temperament	temperament
tief	deep
Tiefe	depth
tot	dead
tötlich	deathly
töten, tötete, getötet	to kill
Trichter	funnel, vortex
triumphieren, triumphierte, getriumphiert	to triumph
Triumph	triumph
tun, tat, getan	to do
Tür	door
über	over
und	and
uns	us
unser,-e,-es	ours
unter	below, under
vierzig	forty
von	of, from
voll	full
vor	ago, before, by
vorher	before
Vortex	funnel, vortex
Wand	wall
was	what, which
Wasser	water
Wasserfass	water barrel
Wasserstand	water level
war	was

waren	were (you, they)	wir	we
wären	were (I, you, they)	wird	(he, she, it) becomes or will
weder...noch	neither...nor	wollen, wollte, gewollt	to want
Weise	manner, mode	worden	(word indicating action in connection with another verb)
weit	far		
welcher,-e,es	who, which		
Welle	wave		
wenn	if		
werden, war, geworden	become, will	Wort	word
West; Westen	West	wurde	was
Wetter	weather	würde	would
wie	how		
wild	wild	zehn	ten
will	(I, you, he) will	Zeit	time
Wildheit	wilderness, wildness	zwei	two
Wind	wind	zwischen	between
		zu	to (direction)
		zu	to (with verbs)
		zu	too

TABLE II

SUMMARY OF TEST RESULTS

Word		Count of Appearances in text up to 10.	Performance of 3 subjects on test. Correct	Wrong	Misse
Ebbe	tide,low	2	3	-	-
Echo	echo	1	3	-	-
einer,-e,-es	a	10	3	-	-
einige	some, several	2	-	1	2
einziger,-e, -es	sole, solitary, single	2	-	2	1
Ende	end	1	3	-	-
er	he	10	3	-	-
erster,-e,-es	first	8	1	1	1
erstens	primarily	9	-	1	2
es	it	10	3	-	-
etwa	approximately, about	2	3	-	-
Expedition	expedition	1	3	-	-
Faden	thread, fathom (ship)	1	-	1	2
fallen, fiel, gefallen	to fall	1	3	-	-
Fass	barrel	3	-	1	2
Fenster	window	1	1	-	2

Table II continued:

Word		Count of Appearances in text up to 10.	Performance of 3 subjects on test. Correct	Wrong	Missed
Figur	figure	1	3	-	-
Finger	finger	1	3	-	-
Fisch	fish	3	3	-	-
fischen, fischte, gefischt	to fish	0	1	2	-
Flut	tide, high, flood	3	1	2	-
Form	form, mode, shape	2	3	-	-
Frau	woman, wife	9	3	-	-
Fundament	base, fundament	1	1	2	-
fünf	five	1	3	-	-
für	for	10	2	1	-
Furie	fury	1	3	-	-
Gedanken	thought	1	-	-	3
gewesen	been	9	-	-	3
gigantisch	gigantic	5	2	-	1
gleichen	to be like	2	-	-	3
Gott	god	3	2	-	1
Grad	degree	1	-	-	3
gross	large, big	1	2	-	1
lang	long	5	3	-	-
langer,-e,-es	long (adj.)	0	3	-	-
länger	longer	4	3	-	-
laut	loud	6	3	-	-
lauter	louder	7	3	-	-
Laterne	lantern	4	3	-	-
Licht	light	1	3	-	-
Mann	man	10	3	-	-
Männer	men	3	2	1	-
mehr	more	2	1	1	1
machen, machte, gemacht	to make	4	1	1	1
Meile	mile	5	2	-	1
Meter	meter	2	3	-	-
Minute	minute	9	3	-	-
mir	me	5	2	1	-
mit	with	10	3	-	-
Mitternacht	midnight	1	3	-	-
Moment	moment	10	3	-	-
Monster	monster	3	3	-	-
Muskel	muscle	2	2	1	-
mein,meine,mein	my (sing.nom.)	10	3	-	-
-es, -er, -es	(sing.gen.)		3	-	-
-em, -er, -em	(sing. dat.)		3	-	-
-en,meine,mein	(sing.acc.)		3	-	-
meine	my (plur.nom. all genders)	10	3	-	-

Table II continued:

Word		Count of Appearances in text up to 10.	Performance of 3 subjects on test. Correct	Wrong	Missed
meiner	my (plur.gen. all genders)		3	-	-
meinen	(plur.dat.all genders)		3	-	-
meine	(plur,acc.all genders)		3	-	-
nächst	next	1	-	1	2
Nacht	night	10	3	-	-
Nächte	nights	1	2	-	1
Name	name	1	3	-	-
Nerven	nerves	1	3	-	-
nicht	not	10	2	1	-
nie	never	7	1	1	1
noch	nor, still, yet, else	10	3	-	-
Norwegen	Norway	1	3	-	-
nun	now	10	3	-	-
nur	only	8	-	1	2
ob	if, whether	2	-	2	1
oder	or	10	3	-	-
offen	open	2	1	1	1
oft	often	4	3	-	-
Ohr	ear	3	2	-	1
Ozean	ocean	10	3	-	-
Tag	day	10	3	-	-
tausend	thousand	1	3	-	-
Teil	part	1	1	-	2
Temperament	temperament	1	3	-	-
tief	deep	1	-	-	3
Tiefe	depth	1	-	-	3
tot	dead	2	3	-	-
tötlich	deathly	1	-	2	1
töten, tötete, getötet	to kill	1	3	-	-
Trichter	funnel, vortex	8	1	1	1
triumphieren, triumphierte, getriumphiert	to triumph	1	3	-	-
Triumph	triumph	0	3	-	-
tun, tat, getan	to do	1	1	1	1
Tür	door	4	2	-	1
über	over, above	10	1	-	2
und	and	10	3	-	-

Table II continued:

Word		Count of Appearances in text up to 10.	Performances of 3 subjects on test. Correct	Wrong	Missed
uns	us	10	1	2	-
unser,-e,-es	ours	0	1	1	1
unter	below, under	7	3	-	-
vierzig	forty	1	1	-	2
von	of, from	10	2	-	1
voll	full	2	-	1	2
vor	ago, before, by	6	1	-	2
vorher	before	1	-	-	3
vortex	funnel, vortex	2	3	-	-
Wand	wall	10	2	-	1
was	what, which	4	-	3	-
Wasser	water	1-	3	-	-
Wasserfass	water barrel	0	1	2	-
Wasserstand	water level	1	-	3	-
war	was	10	2	1	-
waren	were (you, they)	10	2	-	1
wären	were (I, you, they)	2	2	-	1
weder...noch	neither...nor	6	2	-	1
Weise	manner, mode	3	2	-	1
weit	far	1	-	2	1
welcher,-e,-es	who, which	10	1	1	1
Welle	wave	3	1	1	1
wenn	if	6	3	-	-

TABLE III

SAMPLE TEST SENTENCES

Ein alter Mann hatte ein Haus. Ein alter Mann hatte eine Frau. Am 12.Juli 1958 war ich in New York. Es war ein warmer Tag. Ich sah die gigantischen Häuser in New York. Im Ozean sind viele Fische. Ein starker Wind blies über den Ozean. Ein Haus hat vier Wände. In der Wand ist ein Fenster.

TABLE IV

SUMMARY OF SUBJECT PERFORMANCE ON WORD RECOGNITION

	Missed	Wrong	Correct
Subject B.	18	20	80
Subject W.	33	16	72
Subject P.	20	12	83
Total	71	48	235
Total (Percent)	20%	14%	66%